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FABRICATION AND CHARACTERIZATION OF COPPER GRAPHITE COMPOSITE

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ABSTRACT

Metal matrix composites have superior properties and performance in comparison to the pure metals that justifies their added cost. The present work includes fabrication of metal matrix composite having copper as a base metal and Graphite as the reinforcement. The mechanical testing of the fabricated composite is performed and the mechanical properties are compared with the properties of pure Copper. Mechanical properties of the fabricated composite were found superior to the pure metal.

KEYWORDS: Composite Material, Copper, Graphite, Metal Matrix Composite.

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Original Article

INTRODUCTION

Composite materials have light weight and superior properties when compared to the pure metal [1]. The use of Copper composite is quite common in structural applications, transportation and power sector. The modern technology requires materials with lighter weight, higher strength and superior mechanical properties. Copper metal matrix based composite material comprises high tensile strength, high melting temperature, light weight and good wear resistance [2].

In the present work the Copper composite was prepared by the casting. Different compositions of the graphite were selected with the Copper. Mechanical testing of the prepared sample was performed and a comparison of the result is also presented.

SAMPLE PREPARATION

The simplest and most commercially used technique is the casting method. Casting is usually liquid reinforcement contact, which can cause considerable interface reaction. One of the major difficulty is the cost of production in the fabrication of particulate metal matrix composites. Casting is to be considered as one of the cheapest technology available for the fabrication of such composites. In 1968, S Ray introduced casting of metal matrix composites, by introducing alumina particles into Copper melt by stirring molten Copper alloys containing ceramic powders. In casting, mechanical stirring in the furnace is regarded to be the key element. Despite of the technical challenges like achieving uniform dispersion of reinforcement within the matrix, casting is effective way of fabricating such composites. However, improper distribution may affects directly on the properties of the composite material. In the present research, Copper matrix alloy with Silicon Carbide and Graphite reinforcements was fabricated using casting. Such low cost fabrication will enable Copper matrix composite (CMC) to move forward aerospace and defense applications to, CMCs higher volume applications. The Table 1 reflects the

compositions of the samples prepared in the present work. The process of casting, operating parameters and processing and preparation of CMC material using Cu as matrix alloy and reinforcement Graphite have been fabricated by varying weight fractions. Among all well-established metal matrix composite fabrication methods, casting is most economical. Casting is currently the most celebrated commercial method of producing copper based composites. The major advantages are simplicity, litheness and applicability to large quantity production. It is also striking because, in the principle of operation, it allows a conventional metal processing route to be used, and hence minimizes the final cost of the product.

Three types sample of cooper graphite composite material were made through casting process. Firstly, there are mixing of powder of cooper & graphite was performed. Each sample has weight of 200 gm. Later material was melted in the Furness at temperatures of 1190 C to 1350 C. Figure 1 shows the photograph of fabricated samples.

Table 1: Composition-Time –Temperature Required for Fabricating the Samples

Composition	Temperature	Time
Copper 98 %-graphite 2%	**1190** C	**58 min**
Copper 95 %-graphite 5%	**1250** C	**1hr10min.**
Copper 90 %-graphite 10%	**1350** C	**1hr45min.**

Figure 1: Sample of Cu- Gr Composite Material

Mechanical Testing and Results

Table 2 shows the results of hardness test of fabricated composite. It clearly indicates that increasing the graphite in copper increases the hardness of the composite. However, the uniformity of graphite in Cu was not achieved it more than 10 % graphite in Cu was mixed. The hardness of the fabricated composite varies from 40 to 75 BHN. But addition of graphite to copper also migrate the behavior of copper towards brittleness, so an optimization is required as per the application targeted.

Table 2: Hardness Test Results

Composition of Graphite in Sample	Brinell Hardness
Copper 98%-graphite 2%	**40 BHN**
Copper 95%-graphite 5%	**45 BHN**
Copper 90%-graphite 10%	**75 BHN**

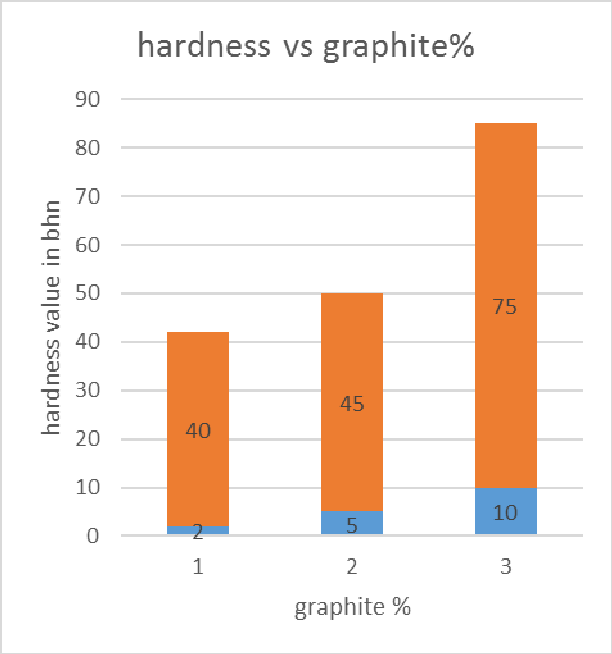

Figure 2: Hardness vs Graphite %

RESULTS

Figure 2 represents the variation between hardness & graphite % in copper matrix. When the graphite % increases in copper than we see that the hardness value of composite material increases the strength of the material.when the graphite 2% -copper 98% the hardness value 40 BHN & graphite 5% - copper 95% the hardness value 45 BHN & graphite 10%-copper 90% the hardness value 75 BHN at % of graphite between 2&5% there is hardness increase only 5 BHN, but when the percentage of graphite increases up to 10% the hardness increases up to 75 BHN in the future work research we increases the % of graphite between 15 to 19 % compare the value.

Tensile Testing

Table 3 shows the results of tensile test of fabricated composite. It clearly indicates that increasing the graphite in copper increases the tensile strength of the composite. The tensile strength of the fabricated composite varies from 40 to 75 BHN.

Table 3

Composition of Graphite in Sample	Tensile Strength (MPa)
Copper 98%-graphite 2%	**159.11 MPa**
Copper 95%-graphite 5%	**171.11 MPa**
Copper 90%-graphite 10%	**183.04 MPa**

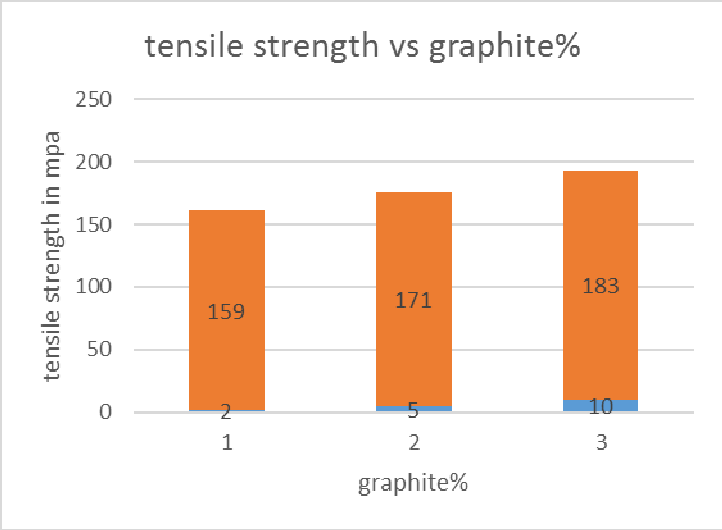

Figure 3: Tensile Strength Vs Graphite %

RESULTS

In tensile testing copper-graphite composite material in above graph When increasing the % of graphite the tensile strength increasing,from the above graph we can say that copper98% graphite2% tensile strength is 159 mpa,copper95%-graphite5% the tensile strength increasing to 171mpa,copper90%-graphite10% the tensile strength increasing to 183mpa.so it shows that as increasing graphite % the tensile strength increasing.for future scope we will research about highest increasing tensile strength up to 350mpa to increasing the graphite % combined with another material.

CONCLUSIONS

In this paper, we have fabricated Cu-Gr metal matrix composite by casting route and analyze its fabrication by casting Process and different mechanical properties like tensile and hardness. And we have examined that tensile strength increases as weight % of graphite increases and hardness increase as weight % of graphite increases.

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